CHEM-C3410 Nanomaterials

Course Information 2022

AALTO UNIVERSITY

SCHOOL OF CHEMICAL ENGINEERING

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The course consists of

- Lectures
- Exercises
- Group Work:
  Create a game around a topic
  “Sustainability of 1D Nanomaterials”
  and write a
  “Game Description and Scientific Basis”
- Online Group Exam (1-3 students/group)

Taking part in the Group Work and Exam are compulsory.

All teaching sessions are face-to-face.

Course Material (for the exam)

1. M.F. Ashby, P.J. Ferreira, D.L. Schodek: Nanomaterials, Nanotechnology and Design - An Introduction for Engineers and Architects, Elsevier 2009.
   pp. 177-239, 257-290. = Chapters: 6, 7 (until Nanocomposites) and 8 **(link to e-book in MyCourses: https://mycourses.aalto.fi/course/view.php?id=36621)**

2. G. Cao, Y. Wang: Nanostructures and Nanomaterials - Synthesis, Properties and Applications, World Scientific 2004.
   pp. 15-42, 205-210, 238-249. = Chapters: 2.1-2.4, 5.8-5.8.1 ,6.1-6.3.2 **(link to e-book in MyCourses: https://mycourses.aalto.fi/course/view.php?id=36621)**

3. A. K. Geim, K. S. Novoselov, The rise of graphene,
   Nature Materials **6** (2007) 183-191.
   ONLY pp. 183-186 and 189-191. https://doi.org/10.1038/nmat1849

4. H. Hu, D. Li, Y. Gao, L. Mu, Q. Zhou, Knowledge gaps between nanotoxicological research and nanomaterial safety*, Environment International* **94** (2016) 8–23.
   ONLY chapters 1-3. http://dx.doi.org/10.1016/j.envint.2016.05.001

5. **Short video lectures, available in MyCourses**

6. **Other course material such as lecture slides and exercises**

All links and materials also in MyCourses:
Links to electronic books and papers, short video lectures, lecture slides etc.

Course Schedule 2022
Period I

WEEK / Dates	THEME	LECTURE 1 Mon 10-12	LECTURE 2 Tue 08-10	WED, 23:59pm Exercise submission	EXERCISE SESSION THU 09-12
Week 36: 5.9.-11.9.	**Introduction & Stability**	Introduction to Nanoscale Science	Stability: Ostwald Ripening and DLVO theory	-	Exercises 1
Week 37: 12.9.-18.9.	**Synthesis & Carbon Nanomaterials**	Synthesis of Nanomaterials and Self-Assembly	Carbon Nanomaterials	*Submit Exercises 1 to MyCourses*	Exercises 2
Week 38: 19.9.-25.9.	**Properties at Nanoscale I-II**	Properties at Nanoscale I: Electrical Properties	Properties at Nanoscale II: Optical	*Submit Exercises 2 to MyCourses*	Exercises 3
Week 39: 26.9.-2.10.	**Properties at Nanoscale III-IV**	Properties at Nanoscale III: Magnetic and Dielectric Properties	Properties at Nanoscale IV: Mechanical and Thermal	*Submit Exercises 3 to MyCourses*	Exercises 4
Week 40: 3.10.-9.10.	**Characterization & Nanotoxicity**	Characterization	Nanotoxicity and Nanosafety	*Submit Exercises 4 to MyCourses*	Exercises 5
Week 41: 10.10.-16.10.	**Start of Science Project**	Lecture: What is Sustainability? Group Work kick-off 1: Instructions	Group Work kick-off 2: Inspirations to Group Work	*Submit Exercises 5 to MyCourses*	**Review of the theory part of the course**

Partly “flipped classroom” → Prepare before sessions

Prepare Before Lecture#	Video or reading material
Lecture 2: TUE 6th Sep	**Video 2a: Young-Laplace and Kelvin equations** (9 min)
Lecture 3: MON 12th Sep	**Video 3a: Methods for Nanomaterial Preparation** (22 min)
Lecture 4: TUE 13th Sep	**Video 4a: Short Introduction to Carbon Nanomaterials** (9 min)
Lecture 5: MON 19th Sep	**Video 5a: Electrical Properties of Nanomaterials** (16 min)
Lecture 6: TUE 20th Sep	**Video 6a: Luminescence** (7 min)
Lecture 7: MON 27th Sep	**Video 7a: Superparamagnetism** (8 min)
Lecture 8: TUE 28th Sep	**Video 8a: Hall-Petch Equation** (5 min)
Lecture 9: MON 3rd Oct	**Read: M.F. Ashby et al., Chapter 8.2. Characterization** (18 pages with lots of pictures)

Link to videos: https://mycourses.aalto.fi/mod/lti/view.php?id=913769
Link to book: https://www.sciencedirect.com/book/9780750681490/nanomaterials-nanotechnologies-and-design

No need to learn or understand deeply before the lecture, just to get some idea – we learn them in lecture

Course Schedule 2022
Period II

WEEK / Dates	MON 10-12	WED 10-12	THU 08-10
Week 43: 24.10.-30.10.			
Week 44: 31.10.-6.11.	Group Work Discussion A Place: Titanium (Circular Raw Materials Hub)	Group Work Discussion B Place: E228 (CHEM)	Group Work Discussion C Place: E228 (CHEM)
Week 45: 7.11.-13.11.			
Week 46: 14.11.-20.11.			
Week 47: 21.11.-27.11.			
Week 48: 28.11.-4.12.	Group Work Gaming Session A Place: Titanium (Circular Raw Materials Hub)	Group Work Gaming Session B Place: Ke3 (CHEM)	Group Work Gaming Session C Place: Ke3 (CHEM)

Discussion: Asking questions, thinking about the basic idea of game

Group chooses either to **A, B or C session from MyCourses**

Grading Criteria

TASK	Points	TOTAL	Compulsory elements required to pass the course	Note
Lectures	-	**-**	-	
Exercises	5 weeks x 3 p/week	**15 p**	-	**PERIOD I** **Submitted to MyCourses on Wednesdays 23:59pm on the next week**
Group Work: **Creating a game "Sustainanability of 1D nanomaterials"**	<u>Peer Grading</u> Playing the game: max.4 p <u>Teachers' grading</u> Quality and Science in the game: max. 12 p	**16 p**	• **Be part of a group** • **Make 1st submission: game idea** • **Make Final submission: motivation (≈introduction), game description and scientific basis of the game, conclusions** • **Be present in one of the game sessions** • **Provide peer-feedback from one of the game**	**Period II** **1st submission: 6th November** **Final submission: 1st December** **Game sessions:** **MON 28th Nov 10-12** **WED 30th Nov 10-12** **THU 1st Dec 08-10**
Exam	4 questions x 5 p	**20 p**	• **Receive min. 7 points of an exam**	
TOTAL		**51 p**	• **Receive total min. 20 p**	

In other words: you must take part + submit the group work <u>AND</u> receive min. 7 points from the exam. <u>ALSO</u>, you must receive min. 20 points of TOTAL points (sum of all tasks)

Exercises and Lectures

Lectures and Exercises

No compulsory attendance on
any lectures or exercises:
there are short video lectures available
in MyCourses

**By attending lectures and exercises
you will become a part of
learning community**

= meet peers, can ask questions and
help your peers

This is the part of university life we took for granted before corona, now let's take full advantage of it again

Exercises

Exercise sessions in Period I, THU 09-12

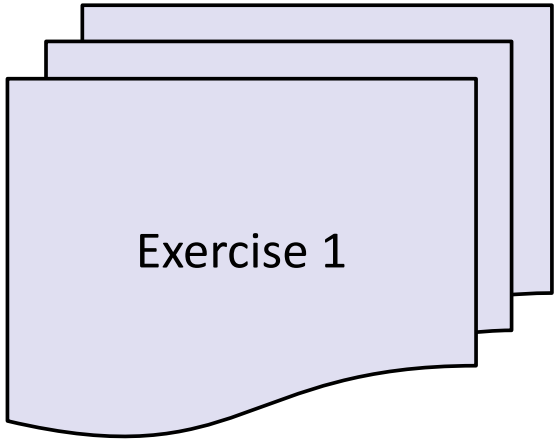
- Place to come and make calculation, and get hints & help from teachers
- In each session, the questions of that week are discussed
- Joining Exercise Sessions is totally voluntary

Exercises are published in MyCourses when the course starts

- 3 Questions / Week and 1 p / question
- 5 Weeks
- **TOTAL: 15 points**

Exercises submitted to MyCourses weekly

- **Wednesdays 23:59 pm, one week AFTER the session in question**
- Calculations, multichoices and Excel exercises are automatically assessed
- Essays are assessed by teachers



About questions

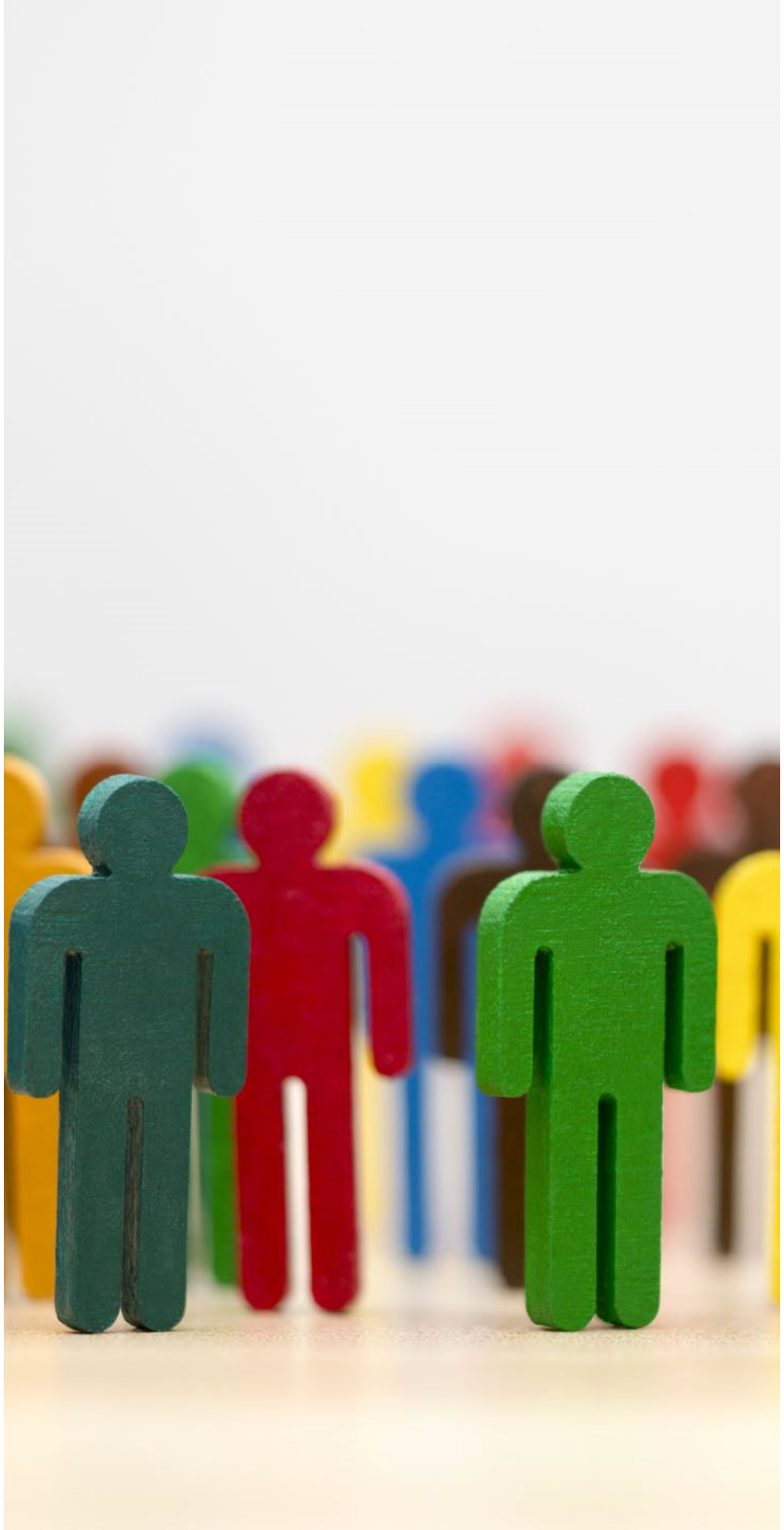
Lectures and exercise sessions are the best places for questions.
All questions are welcomed and strongly encouraged in teaching sessions: it is one of the best ways to learn.

ZULIP (chat) tool is used in MyCourses for further questions

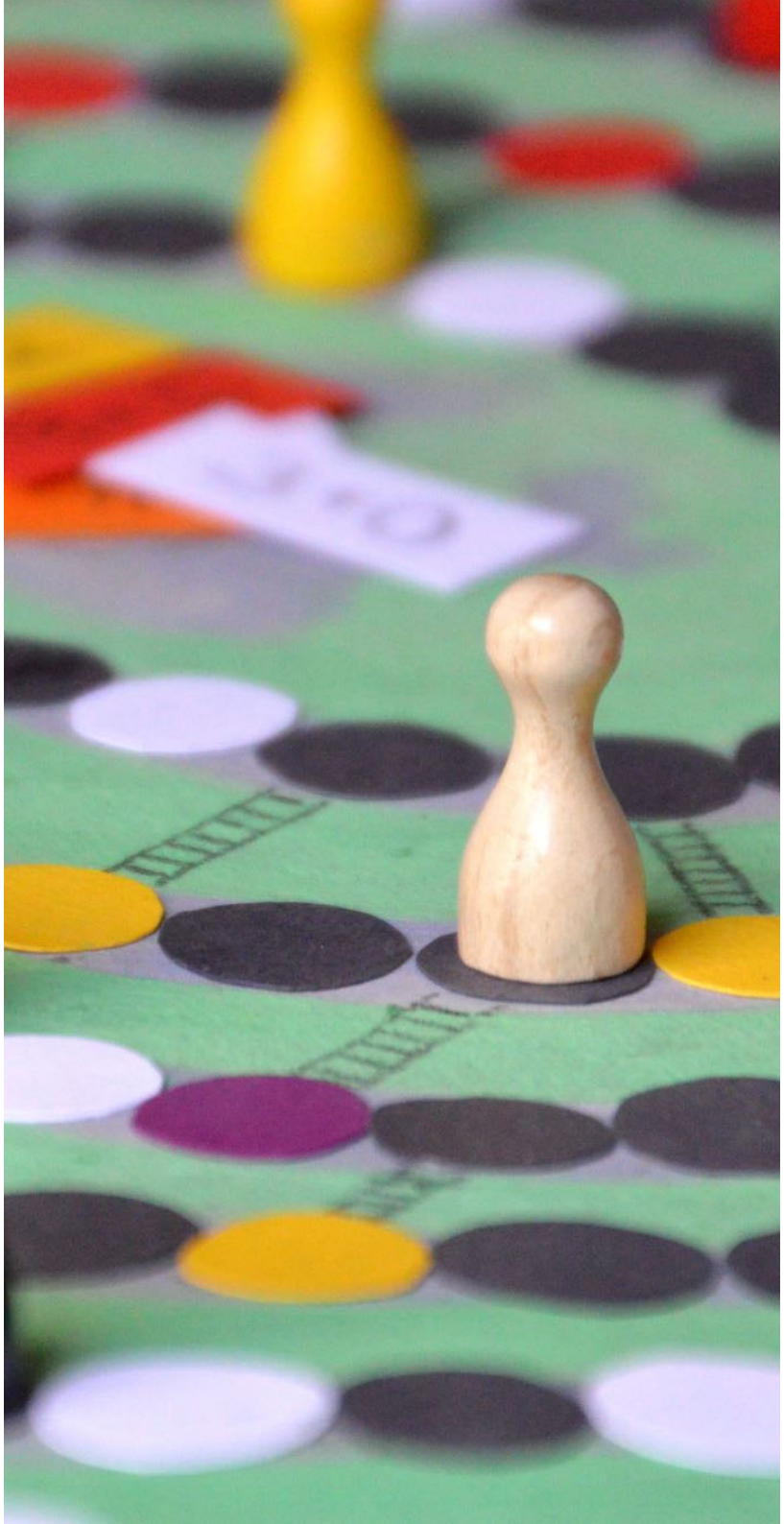
- You can ask a question and answer to other students at any time → helping and learning together is an important working-life skill
- ZULIP chat compares to questions in lecture hall: you will log in with Aalto credentials (=your name is visible) and we follow Aalto's Code of Conduct
- Do not copy-paste/show a partial or full answer to the chat: tell the question number and teachers can find your answer from MyCourses

→ A course assistants will go through ZULIP questions of the exercise round in question (WEEK1, WEEK2,…) on Tuesdays = questions arrived by Monday midnight will be seen

<u>No emailing questions about exercises,</u>
but rather ask them either in teaching sessions or ZULIP:
we want to share all the information with all the students



Group Work



Group Work

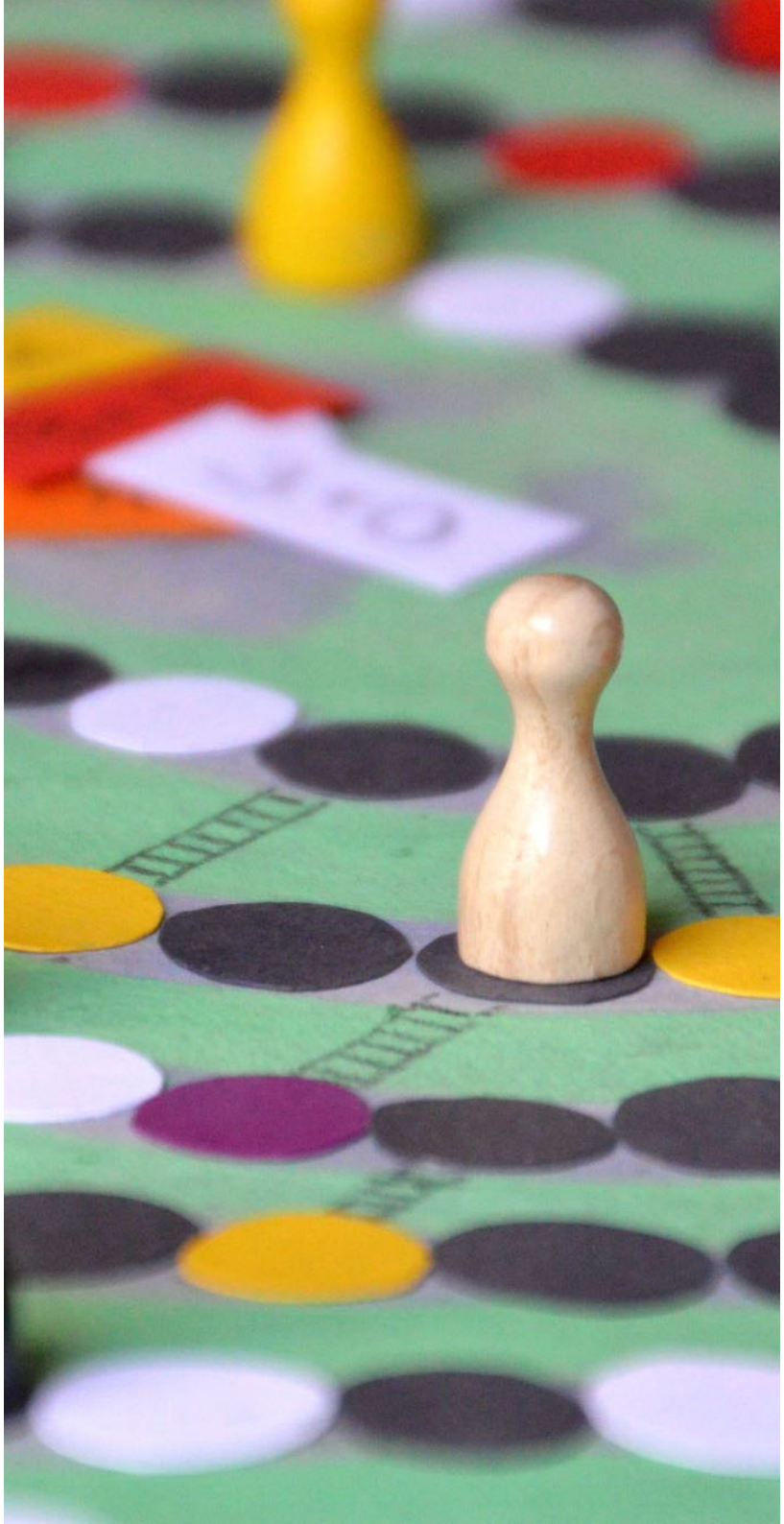
Create a game
“Sustainability of 0D or 1D Nanomaterials”

and write a

“Game Description and Scientific Basis”

including Motivation (≈Introduction) and scientific background of 0 D or 1D nanomaterials utilized in the game

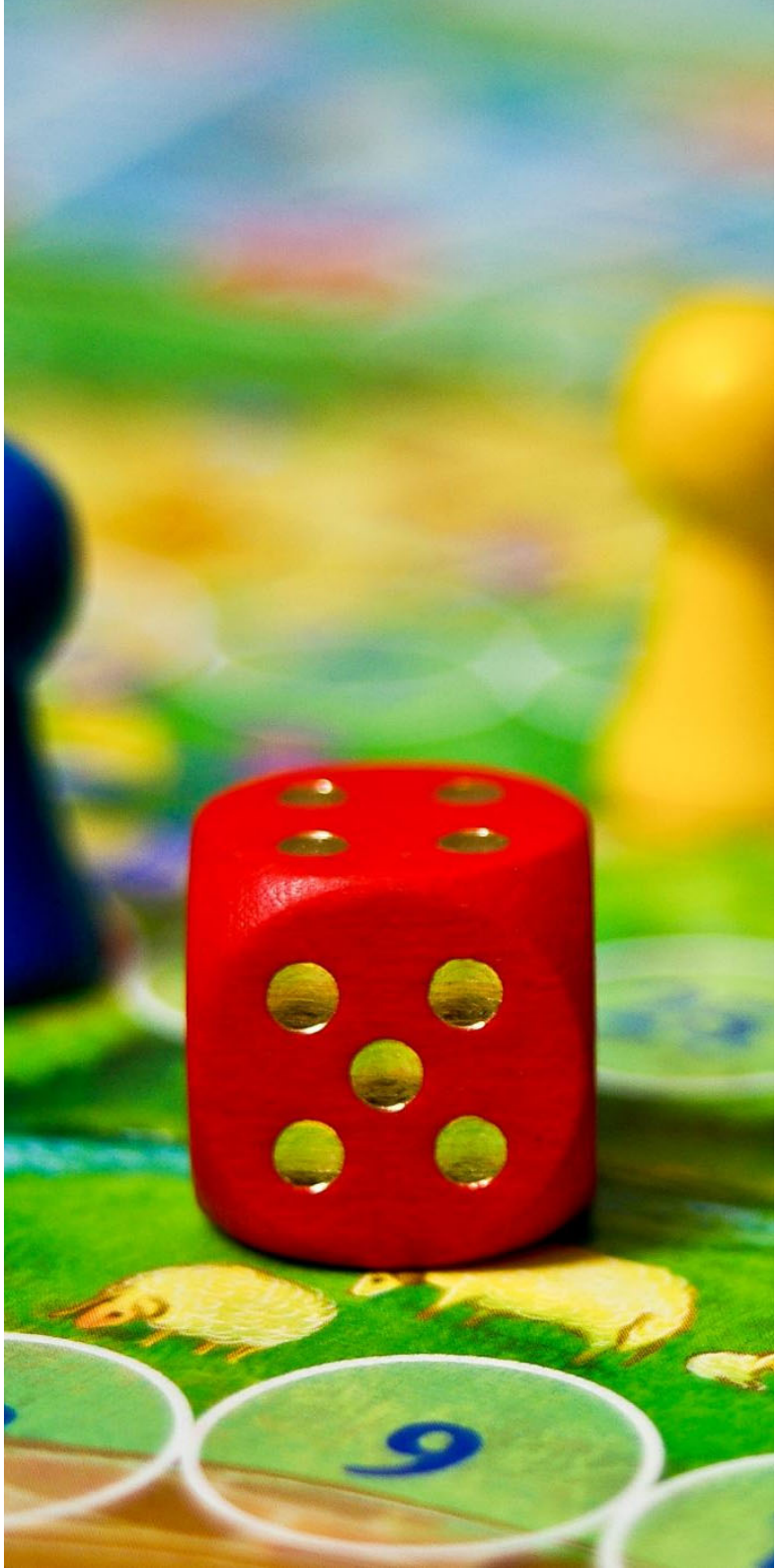
As a group you can buy material for the game with max. 15 €/group:
bring the receipt and you will get your money back.



Boundary Conditions

- The game should be around only **ONE 0D or 1D nanomaterial and their sustainability in 1-2 application(s): which 0D or 1D material and application(s)? This is your choice.**
- "Game Description and Scientific Basis" document contains motivation, the scientific basis of the game and conclusions (.docx format with sub-headings provided in MyCourses)
- The game can be played Face-to-Face in appr. 30 mins
- Explaining instructions should not take longer than 5 mins
- The game should take 3+ people (of age 18+)
- The game includes at least one feedback loop and one normative decision/discussion*

**In Lecture 11 we go through what are feedback loops and normative decisions*



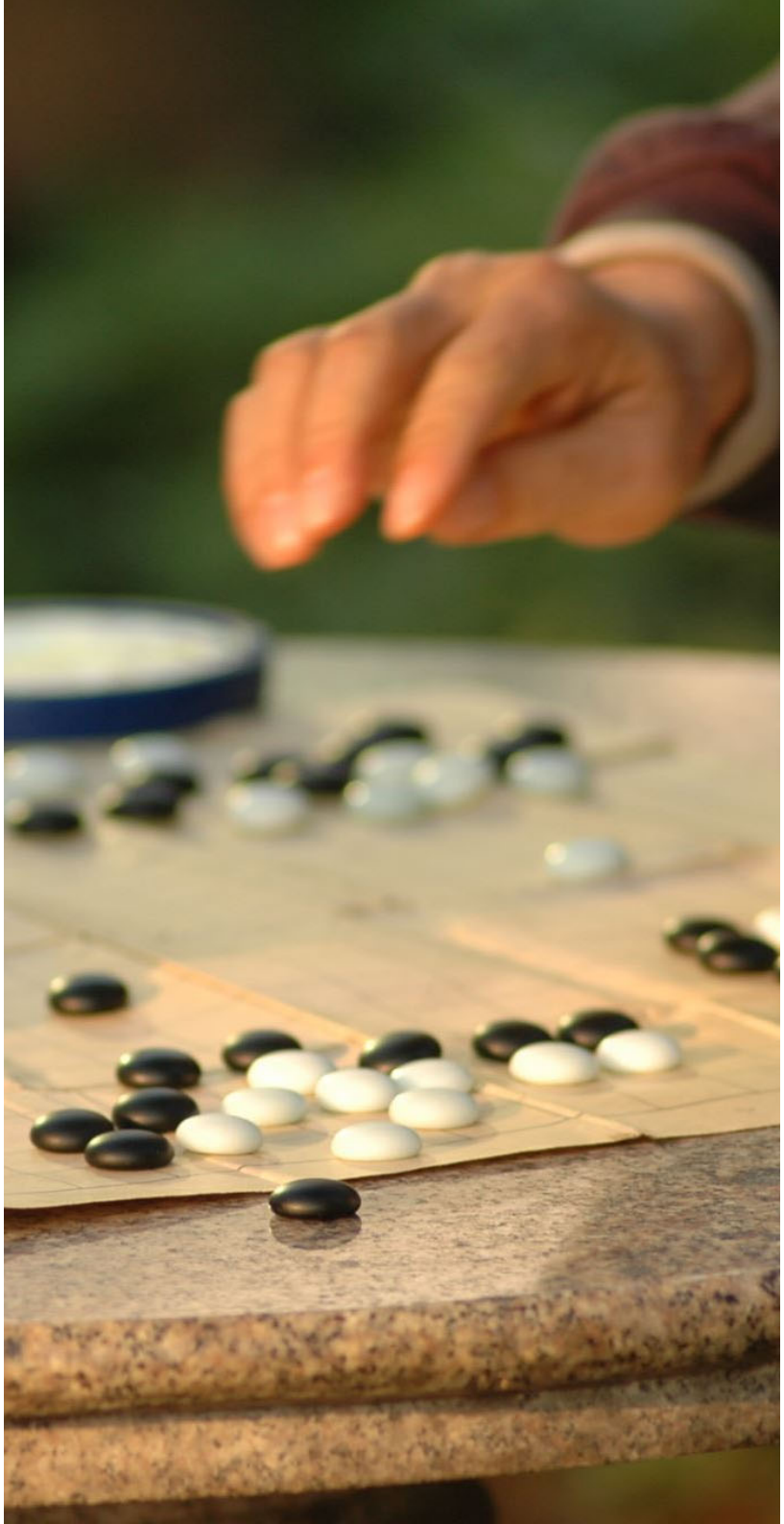
What is Game Description?

It is a group report which reflects your scientific knowledge of the selected 0D or 1D nanomaterial in the selected 1-2 applications from sustainability points of view.

Structure of Game Description

1. **Motivation**
2. **Short description of the game**
3. **Material and Scientific Basis of the Game**
   - This part especially shows your scientific knowledge of the topic. Remember correct scientific referencing.
4. **Conclusion**
5. **References**

MyCourses has a Game Description document with more details about what is expected under each heading: it is recommended to use it as a format for Game Description report.



Group Work Deadlines

1st Submission = Game Plan
SUN 6th November, 23:59pm

- Name the selected 0D or 1D nanomaterial and 1-2 applications
- Explain the NON-detailed idea of the game, shortly
- List 7-10 references related to the selected nanomaterial in selected applications and/or their sustainability
- Length: one A4 page + references
- This is **compulsory submission, but not graded.**

Bring your game to one of these sessions:
MON 28th Nov (10-12) , WED 30th Nov (10-12) or
1st DEC (08-10)

- Your group **must attend one of these sessions**
- Teach and play your game with another group; learn and play one game created by other group
- Provide feedback from the other group's game (fill the form): peer-feedback will provide the grade about the game itself → **4 p**

Final Submission = Game Description and Scientific Basis:
SUN 4th December, 23:59pm

- Teachers' will evaluate your game and scientific knowledge by this report → **12 p**

Group Work Timetable

PERIOD I		
Week/Dates	**LECTURE 1 Mon 10-12**	**LECTURE 2 Tue 08-10**
WEEK 41 10.10.-16.10.	**Group Work Kick-off 1:** Detailed instructions to Group Work What is Sustainability?	**Group Work kick-off 2:** Inspirations to Group Work: for example, teacher will bring commercial sustainability games to this session

PERIOD II				
WEEK / Dates	**Mon 10-12**	**Wed 10-12**	**Thu 08-10**	**Agenda**
Week 44: 31.10-6.11.	**Group Work Discussion A Place: Titanium (Circular Raw Materials Hub)**	**Group Work Discussion B Place: E228 (CHEM)**	**Group Work Discussion A Place: E228 (CHEM)**	• **Voluntary attendance**: book a session as a group, and come and ask for help
Sunday 6th November 23:59pm	**Submit "Game Plan" = one A4 + references: the selected material, applications and basic idea of the game + 7-10 references**			
Week 48: 28.11.-4.12.	**Gaming Session A Place: Titanium (Circular Raw Materials Hub)**	**Gaming Session B Place: Ke3 (CHEM)**	**Gaming Session C Place: Ke3 (CHEM)**	• **Compulsory attendance** to one of these sessions: book a session as a group • **Bring your ready game to the session** • Play games: yours and one other group • **Provide feedback of the other group's game**
Sunday 4th December 23:59pm	**Submit "Game Description and Scientific Basis" to MyCourses**			

Group Work Practicalities

- Group size depends on the number of participants of the course: there will be 18 groups in this course (appr. 5 students/group)
- **Groups are selected in MyCourses no later than 11th October**

More details of the group work in the last week of Period I

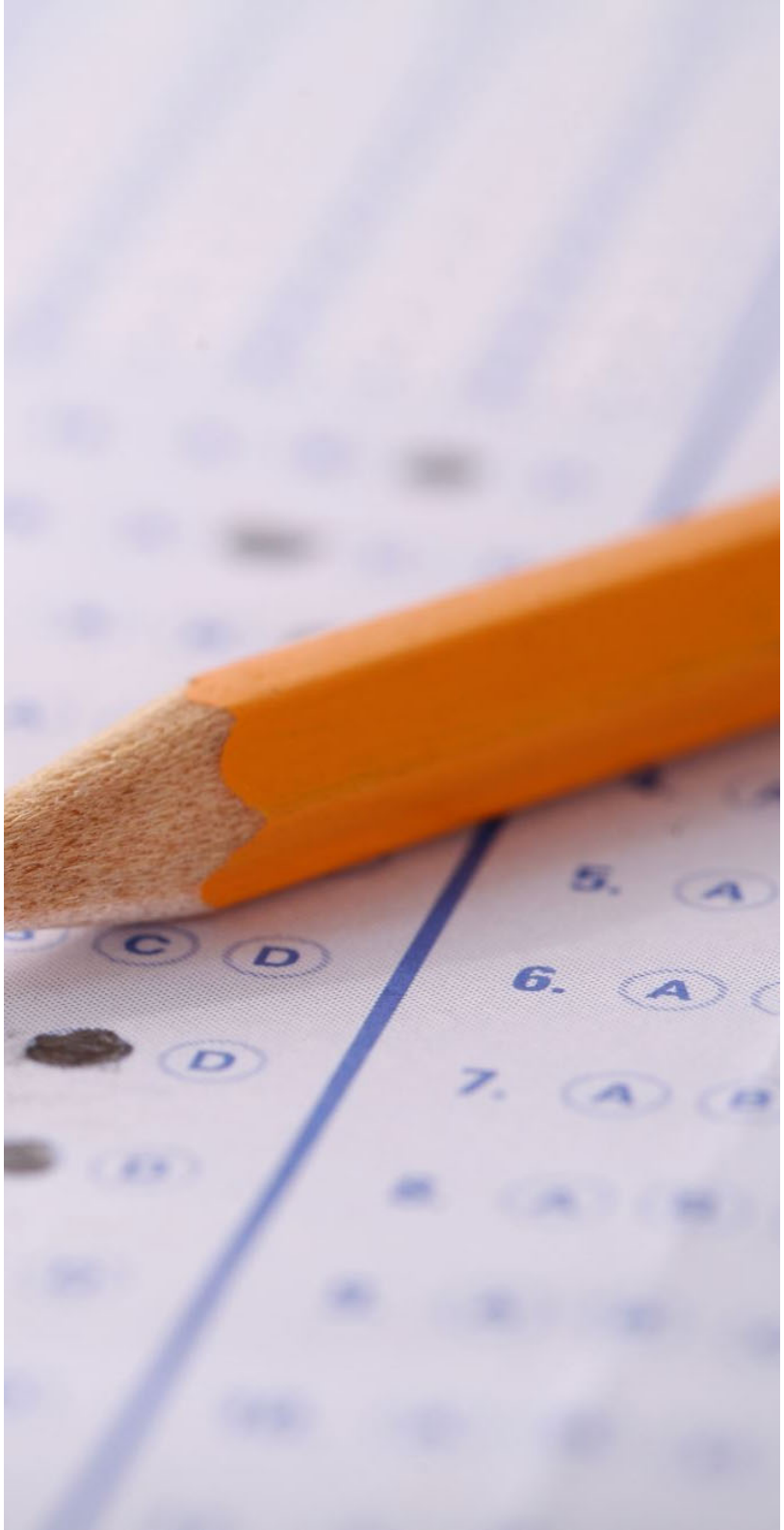
Lecture 11 (10th October, 10-12): Group Work Kick-off

- What is sustainability? What are sustainability competences?
- Introduction to the group work: grading, groups, etc.
- If you do not know people in this course**, this is also the last place to find yourself a group**

Lecture 12 (11th October, 08-10): Inspiration to Group Work

- Teacher will bring examples of commercial sustainability games

*MyCourses has a **Game Description and Scientific Basis** document with more details about what is expected from this report:* ***it is recommended to use it as a format for the document.***



Online Group Exam

Possible Exam Times

- **Course Exam - option 1: 21st October 2022, 09:00-13:30**
  remember to choose the group by 13th October
- **Course Exam - option 2: 7th December 2022, 09:00-13:30**
  remember to choose the group by 30th November
- **Make-up Exam: 21st February 2023, 09:00-13:30**
  remember to 1) register in **SISU** and 2) choose the group by 13th February

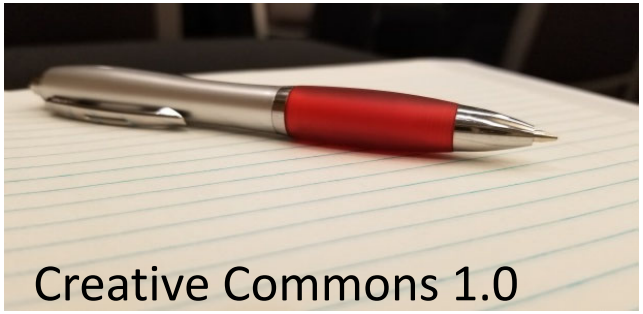
There are three possible times to take the exam.

- You need to pass one of them (min. 7 points).
- You can attend even all of the exams if you want: the best grade will be valid.

You cannot make this course simply by exam = Group Work is also compulsory

ONLINE Group Exam

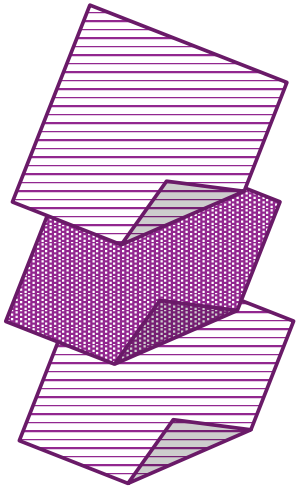
- **Exam is done in groups of 1 – 3 persons**
  - The whole group will get the same points
  - The group must be chosen in MyCourses a week before the exam
    - **CHOOSE THE GROUP ALSO IF YOU TAKE THE EXAM ALONE (OTHERWISE YOU CANNOT SUBMIT THE EXAM TO MYCOURSES)**
  - *If someone randomly joins your group: inform Kirsi Yliniemi 6 days before the exam and the person is removed (he/she will do the exam alone)*
- **All communication is allowed within the group, but communication is NOT allowed outside the group**
- **You are allowed to use course material or google but you are NOT allowed to ask help outside your group (not ask help from friends, partners, chats, forums etc.)**



ONLINE Group Exam

How does this work?

- Choose the exam group in MyCourses one week before the exam
- Questions are published in MyCourses at the start of the exam
- Answer to the questions as a group
- Combine answers **to ONE PDF file and submit to MyCourses** before the exam time is finished
  - You can answer by pen/pencil +paper, by computer or both
  - For essays etc. text you may use computer (it is actually preferred), but of course you can also write answers by hand.
  - Calculations you can also do by hand or by computer: but you always must show equations & substitution of numbers to all necessary steps, unit analysis, correct accuracy (simple copy-paste from Excel sheet is not enough)
  - Hand-written answers: take a photo and embed to the Word-document on which you have answers by computer. Check that everything is readable.
  - Create then a pdf.



HINT! Save the last 30 mins of the exam time to combine answers, create pdf and submit to MyCourses

The exam is planned so that 4 h is enough to answer to the questions.

Exam Questions

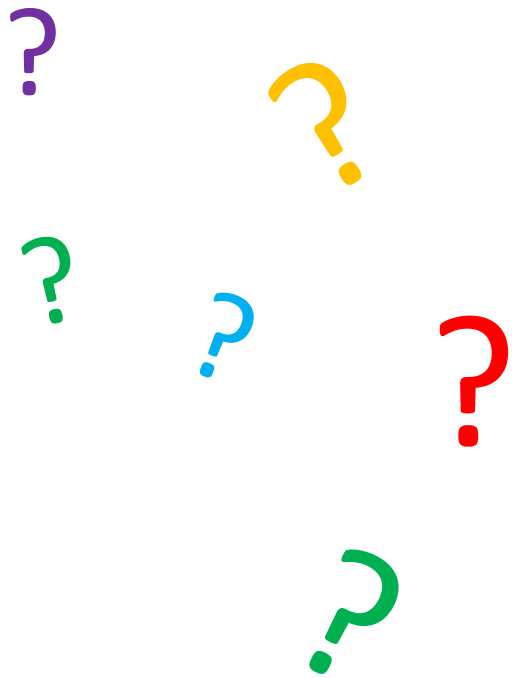
Answer to all 4 questions (each question 5 p)

- A question may have (a), (b), etc. parts

→Answer all these parts

A question can be

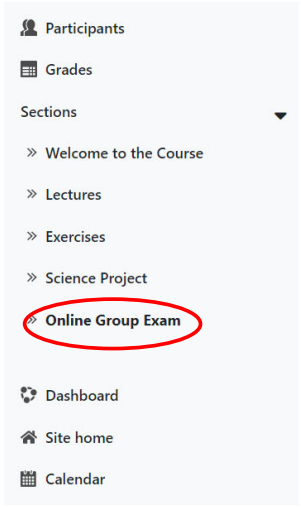
- A calculation
- An essay or explanation of some observation
- Explanation of a research result
- Finding a paper and reviewing (parts of) it with own words
- A combination of all above
- *Hint:* ***more essays& explanations*** *than calculations*

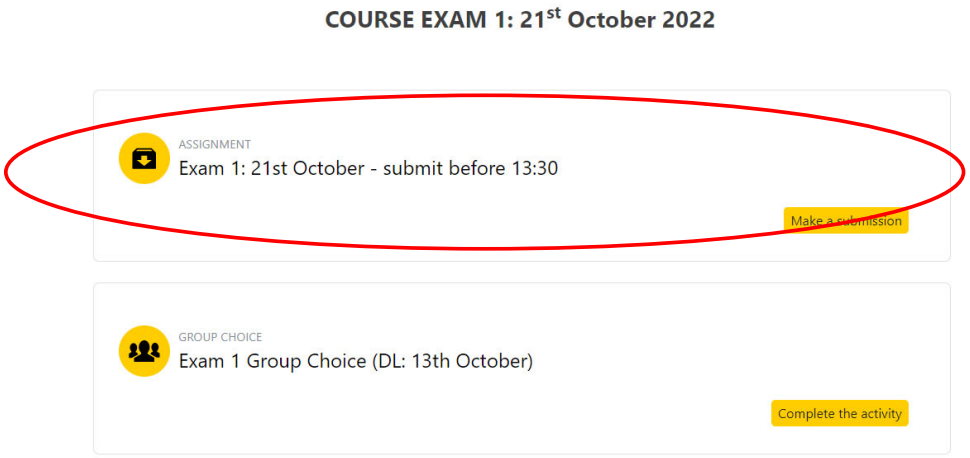


Always when answering,
think that you are showing what you know,
not testing what the reader knows
(i.e. do not make the reader to guess)

When the Exam Starts

- Go to the MyCourses
- **Refresh your browser at the starting time of the exam**
- The exam submission box should become visible
- Exam questions can be found from the Submission box





Click this open and you will find the questions

Depth of Answering in Exam

- The **exam is evaluated based on the depth of understanding** rather than a simple statement of key facts (e.g. NO bullet point list).
- In essays, **do not make reader to guess what you know and mean, but write it clearly out → in-depth answers.**
- In calculations, show the equations & the different steps (with substituted numbers and unit analysis) and use the correct accuracy.
  - *Simply copy-paste from Excel sheet is not enough.*
- It is allowed to use course material and Google/Search Engines. You can also use schematics & figures (also from the books, papers etc. you may find) to make your explanations deeper BUT you must also explain them in your written answer. All text should be your own (no plagiarism).

Submitting Your Exam Answers

Must be done before the ending time of the exam

- It is enough if one group member makes the submission

You can submit only ONE pdf file

- You can answer by pen/pencil + paper, by computer or both – but you must combine all your answers to one file and create a pdf.
- Make certain that all figures and text are easily readable: too dark pictures, text which cannot be read, etc. → 0 p
- **Practice creating a pdf file already beforehand**

You can submit only if you have chosen the exam group

- You must choose the group even if you took exam alone (group size 1-3 persons)
- You must choose a new group to every exam

Emergencies during the exam

*E.g. MyCourses is not responding… or other **emergencies***

- CALL Kirsi Yliniemi (+358 50 592 3690)
- You are provided a licence to submit the answers by email
- Answers must be sent before the end of exam time
- However, you MUST submit exam answers ALSO to MyCourses **as soon as possible**
- **ONLY MYCOURSES SUBMISSIONS WILL BE GRADED**

During the exam: contact Kirsi only in emergency = i.e. no "help in understanding question X" etc.

- If there is a mistake in questions, it will be taken care in grading
- Just write it in your exam paper

Reasoning Behind the Tasks

Lectures:

- Learning the theoretical background
- Concept checks and discussions to deepen the knowledge right away

NOTE! There are short video lectures available in MyCourses

Exercises:

- Deepening the understanding
- Learning with friends

Group Work

- Learning about nanomaterials, their applications and sustainability
- Group Work Skills
- Doing things together

Online Group Exam

- Overview of the course: read also the appropriate sections from course books and selected papers
- Solving problems more like in a real working life: in a small group, in a hurry, trying to bring out the best parts of the team